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ABSTRACT

This pamphlet gives definitions and symbols for the basic and derived metric units, prefixes, and conversion factors for units frequently used in water resources. Included are conversion factors for units of area, work, heat, power, pressure, viscosity, flow rate, and others. (BB)

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SYSTEM INTERNATIONAL D'UNITES

METRIC MEASUREMENT IN WATER RESOURCES ENGINEERING

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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Published by the Universities Council on Water Resources as a service to its members and others engaged in water resources research and educational activities.

The Universities Council on Water Resources hopes that this pamphlet will be helpful and useful to its members, and to others engaged in water resources research and educational activities. It is recognized, however, that as this goes to press, there is uncertainty on a number of items related to SI and its usage. Present plans call for reviewing and revising this booklet within the next two years, if demand for it warrants the effort. During this period, perhaps some of the uncertainties will have been resolved; if so, this will be reflected in the new edition. In addition, we welcome any suggestions for corrections, additions, or deletions that might make the second edition more complete and more useful. Such corrections should be forwarded to:

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SYSTEM INTERNATIONAL D'UNITES

METRIC MEASUREMENT IN WATER RESOURCES ENGINEERING

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The Universities Council on Water Resources

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June, 1976

System International d'Unites
METRIC MEASUREMENT IN WATER RESOURCES ENGINEERING

Introduction

Measurements that describe quantities used in water resources engineering are expressed in a variety of traditional ways. These include such terms as the acre-foot, the second-foot-day, cubic feet per second per square mile, inches per square mile, U.S. gallons per minute, Imperial gallons per minute, and the miner's inch. Because of this diversity of terms, conversion of numbers among the U.S. customary measurement system, the English measurement system, and the metric measurement system (which includes some variations among user countries) has long plagued students and teachers alike.

Today, long overdue, the United States officially is shifting over to a new, internationally recognized and adopted system for measurement; *System International d'Unites*, or, SI. Over the next several years, students and practitioners in water resources engineering will need to be conversant in two or more measurement systems—the new SI, as it is phased in, and the older U.S. customary, English and metric systems as they are phased out of use. Even further into the future some practitioners will need to remain conversant in the older as well as the SI systems in order to make use of data published prior to the introduction of SI.

This pamphlet has been prepared by a task committee of the Universities Council on Water Resources. It is intended as a convenient reference for students and professionals in water resources engineering and for all others whose work may bring them into contact with this field of technology. Basic information on SI and its usage is presented. Conversion relationships are also presented between SI and other currently used measurement systems.

SI—What It Is

The *System International d'Unites* was adopted in 1954 and formally named in 1960 by an International General Conference on Weights and Measures. It is a modernized metric system to permit exact definitions and to eliminate differences in standards among member nations. Improvements in this system have been made at subsequent international conferences. *The System International d'Unites* is officially abbreviated SI in all languages. It includes units most frequently used in the various fields of science and industry.

The American Society of Civil Engineers (ASCE) resolved in 1970 to actively support conversion to SI, including the immediate dual use of SI with U.S. customary units in all ASCE publications, and to adopt the revised edition of the American Society for Testing and Materials (ASTM) Metric Practice Guide[1] for use by ASCE and its membership.

For some measures, *the SI units differ from the old metric units previously used*; therefore, some attention must be given to avoid confusion between the old metric and new international measurement languages.

The Nature of SI Units

Like predecessor systems, SI consists of a limited number of basic units that describe fundamental quantities and a large number of derived units that come from the basic units to describe other quantities. SI has seven base units and two supplementary units from which are developed the large number of derived units used in everyday measurement. The SI base and supplementary quantities, their units and symbols are given in Table 1. Among these, four quantities—length, mass, time and temperature—have broad water resources applications. The remaining five quantities find a much lesser degree application in the more specialized subfields of water resources engineering.

There is considerable concern about whether the *-er* or *-re* spelling of meter and liter should be followed. The 1974 ASTM Metric Practice Guide uses the *-re* form. However, the use of the *-er* form appears to be gaining more recent governmental support. Because of its familiarity, the *-er* form is used here until such time as a national policy may be set.

The derived quantities, their units and symbols, and the formulas that express them in terms of base units are given in Table 2.

Because the orders of magnitude of many quantities cover wide ranges of numerical values, fourteen SI prefixes have been established to deal with decimal point placement. These prefixes, their SI symbol, and the multiplication factors that they represent are given in Table 3.

SI Style and Usage

SI prefixes representing steps of 1000 are used to indicate orders of magnitude. Prefixes that represent steps of 10 and 100 do exist (hecto, deka, deci and centi) but should be avoided unless a strong reason exists for their use; for example, with area and volume when used alone. When five or more digits are used to give the numerical value of a quantity, spaces are used instead of commas to set off groups of three digits (each 1000 multiplier), count-

[1]ASTM, *Metric Practice Guide*, Report E 380-74, Philadelphia, 1974.

ing to the left and right of the decimal point. Where a numerical value is less than 1, a zero should be placed before the decimal point. Double or hyphenated prefixes should not be used (e.g.; use GW but not kMW to represent 10^9 watts). Prefixes may be applied to the numerator but not to the denominator of compound units, the denominator being in SI base units and the numerator prefix adjusting for order of magnitude. The prefix symbol is considered as part of the unit symbol immediately following it, as though it were a new symbol. This can be raised to exponential powers and can be combined with other symbols to form compound symbols (e.g.; $1mm^2/s = 1\ (mm)^2/s = (10^{-3}m)^2/s = 10^{-6}m^2 \cdot s^{-1}$).

TABLE 1. BASE AND SUPPLEMENTARY UNITS IN SI MEASUREMENT

Quantity	Unit	SI Symbol
Base Units:		
length	meter	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd
Supplementary Units:		
plane angle	radian	rad
solid angle	steradian	sr

TABLE 2. DERIVED UNITS IN SI MEASUREMENT

Quantity	Unit	SI Symbol	Formula
acceleration	meter per second squared	...	m/s^2
activity (of a radioactive source)	disintegration per second	...	(disintegration)/s
angular acceleration	radian per second squared	...	rad/s^2
angular velocity	radian per second	...	rad/s
area	square meter	...	m^2
density	kilogram per cubic meter	...	kg/m^3
electric capacitance	farad	F	A·s/V
electrical conductance	siemens	S	A/V
electric field strength	volt per meter	...	V/m
electric inductance	henry	H	V·s/A
electric potential difference	volt	V	W/A
electric resistance	ohm	Ω	v/A
electromotive force	volt	V	W/A
energy	joule	J	N·m
entropy	joule per kelvin	...	J/K
force	newton	N	$kg \cdot m/s^2$
frequency	hertz	Hz	s^{-1}
illuminance	lux	lx	lm/m^2
luminance	candela per square meter	...	cd/m^2

TABLE 2. (cont'd) DERIVED UNITS IN SI MEASUREMENT

Quantity	Unit	SI Symbol	Formula
luminous flux	lumen	lm	cd·sr
magnetic field strength	ampere per meter	...	A/m
magnetic flux	weber	Wb	V·s
magnetic flux density	tesla	T	Wb/m^2
magnetomotive force	ampere	A	...
power	watt	W	J/s
pressure	pascal	Pa	N/m^2
quantity of electricity	coulomb	C	A·s
quantity of heat	joule	J	N·m
radiant intensity	watt per steradian	...	W/sr
specific heat	joule per kilogram-kelvin	...	J/kg·K
stress	pascal	Pa	N/m^2
thermal conductivity	watt per meter-kelvin	...	W/m·K
velocity	meter per second	...	m/s
viscosity, dynamic	pascal-second	...	Pa·s
viscosity, kinematic	square meter per second	...	m^2/s
voltage	volt	V	W/A
volume	cubic meter	...	m^3
wavenumber	reciprocal meter	...	(wave)/m
work	joule	J	N·m

TABLE 3. SI PREFIXES

Prefix	SI Symbol	Multiplication Factor	
tera	T	1 000 000 000 000 = 10^{12}	= E+12
giga	G	1 000 000 000 = 10^{9}	= E+9
mega	M	1 000 000 = 10^{6}	= E+6
kilo	k	1 000 = 10^{3}	= E+3
hecto**	h	100 = 10^{2}	= E+2
deka**	da	10 = 10^{1}	= E+1
deci**	d	0.1 = 10^{-1}	= E−1
centi**	c	0.01 = 10^{-2}	= E−2
milli	m	0.001 = 10^{-3}	= E−3
micro	μ	0.000 001 = 10^{-6}	= E−6
nano	n	0.000 000 001 = 10^{-9}	= E−9
pico	p	0.000 000 000 001 = 10^{-12}	= E−12
femto	f	0.000 000 000 000 001 = 10^{-15}	= E−15
atto	a	0.000 000 000 000 000 001 = 10^{-18}	= E−18

**Avoid use of this prefix where possible.

Of the SI base units, only the unit for mass (the kilogram) contains a prefix. But in using decimal multiples or submultiples for mass, prefixes are attached to the word "gram" (e.g.; megagram or milligram).

The U.S. customary gravimetric engineering measurements treat force as a base unit and mass as a derived unit. In SI, the

reverse is the case. The older metric systems use kilogram-mass and kilogram-force, which causes confusion. The force unit in SI is the newton whereas the kilogram is restricted to the measurement of mass. Pressure (force per unit area) is expressed in units of its defining derived quantities, newtons per square meter, but is also given a distinctive unit name, the pascal. (This situation is also the case for some other derived quantities.) To distinguish between gage pressure and absolute pressure, the word "pressure" is given the appropriate adjective but no modification is made to the symbol Pa (pascal).

The 1974 Metric Practice Guide of ASTM notes that certain deviations from SI may be acceptable in certain cases, as with temperature and angles. Although the unit for temperature in SI is the kelvin, it is permissible to use the degree Celsius. (One kelvin exactly equals one degree Celsius but 0 degrees Celsius equals 273.15 kelvins.) The SI unit for plane angle is the radian; but it is permissible to use the arc degree and its decimal submultiples when the radian is not convenient.

Symbols are used in the singular form, not as plurals (e.g.; 5m but not 5 ms). Symbols are not capitalized in SI unless the unit is derived from a proper name *and* is abbreviated (e.g.; kelvin, K; or pascal, Pa). No period is used after an abbreviated SI unit symbol except at the end of a sentence. The only numerical prefixes which are capitalized are T, G and M.

Text material and tables, during the years of transition, may state quantities in SI units and add another set of units, the latter to be shown in parentheses.

Equations should not contain dual sets of units because of the possibilities for confusion. Instead, the equations should be restated a second time, so that SI is used once and the older customary system shown separately for reference. This separation avoids errors in use of numerical "constants" that actually have unexpressed units.

The units of some terms that contain multiple symbols need special attention. The product of two or more units is denoted by a multiplication dot. Quotients are designated by placing a sloped line (slash) between all units of the numerator and all units of the denominator. All symbols to the left of a slash are in the numerator and all symbols to the right are in the denominator.

Comparison and Conversion Among Systems

Comparison of order of magnitude of quantities and conversion of numbers between SI and other measurement systems can be expected to be necessary for many years. A large number of such conversions have been assembled here for convenient reference.

Table 4 presents numerical values to convert to SI units from

several commonly used units. This is done for the physical quantities most frequently used in U.S. water resources practice. The conversion factors are shown here to four significant figures, which is adequate for most uses. Where needed, the factors are written with the letter E (for exponent) followed by a plus or minus sign and a digit. This indicates the exponential power of 10 by which the number must be multiplied. For example, 1.000 E+4 equals 1.000×10^4 or 10 000. Table 4 has been classified according to the type of physical quantity. The classification is arranged alphabetically.

Table 5 presents in comparative form the equivalent units in SI and other measurement systems for the common physical quantities of length, area, volume, discharge, velocity, mass and force. The equivalent values are given to four significant figures with exponential notation (where needed) as in Table 4.

Table 6 provides numerical values for some commonly used physical properties. Because the given properties of water do depend upon temperature, their numerical values are chosen for one or two typical temperatures. Numerical values are given to three significant figures except for atmospheric pressure, given to four significant figures.

TABLE 4. CONVERSION TO SI UNITS FOR PHYSICAL QUANTITIES FREQUENTLY USED IN WATER RESOURCES PRACTICE

To Convert From:		Multiply By		To Obtain:	Units
Acceleration					
foot/second^2	×	0.304 8	=	meter/second^2	m/s^2
Area					
acre	×	4 047	=	meter^2	m^2
foot^2	×	0.092 90	=	meter^2	m^2
hectare	×	1.000 E+4	=	meter^2	m^2
inch^2	×	6.452 E−4	=	meter^2	m^2
mile^2	×	2.590 E+6	=	meter^2	m^2
yard^2	×	0.836 1	=	meter^2	m^2
Bending Moment or Torque or Moment of Force					
foot-pound$_{force}$	×	1.356	=	newton-meter	N·m
Capacity (see Volume)					
Density (see Mass/Volume)					
Discharge (see Volume/Time)					
Energy or Work					
BTU	×	1 055	=	joule	J
calorie	×	4.187	=	joule	J
foot-pound$_{force}$	×	1.356	=	joule	J
kilowatt-hour	×	3.600 E+6	=	joule	J
Energy/Area Time					
BTU/foot^2-second	×	1.135 E+4	=	watt/meter^2	W/m^2

TABLE 4. (cont'd) CONVERSION TO SI UNITS FOR PHYSICAL QUANTITIES FREQUENTLY USED IN WATER RESOURCES PRACTICE

To Convert From:	Multiply By:	To Obtain:	Units
BTU/foot^2-hour	× 3.152	= watt/meter^2	W/m^2
calorie/cm^2-minute	× 697.3	= watt/meter^2	W/m^2
Flow Rate (see Mass/Time or Volume/Time)			
Force			
dyne	× 1.000 E−5	= newton	N
kilogram$_{force}$	× 9.807	= newton	N
kip	× 4 448	= newton	N
pound$_{force}$	× 4.448	= newton	N
Force/Area (see Pressure)			
Heat			
BTU/foot^2	× 1.136 E+4	= joule/meter^2	J/m^2
BTU/hour-foot^2-°F	× 5.678	= watt/meter^2-kelvin	W/m^2·K
BTU/pound$_{mass}$	× 2 326	= joule/kilogram	J/kg
BTU/pound$_{mass}$-°F	× 4 187	= joule/kilogram-kelvin	J/kg·K
BTU/second-foot^2-°F	× 2.044	= Watt/meter^2-kelvin	W/m^2·K
calorie/cm^2	× 4.184 E+4	= joule/meter^2	J/m^2
calorie/gram	× 4 187	= joule/kilogram	J/kg
calorie/gram-°C	× 4 187	= joule/kilogram-kelvin	J/kg·K
Length			
foot	× 0.304 8	= meter	m
inch	× 0.025 40	= meter	m
mile, nautical	× 1 852	= meter	m
mile	× 1 609	= meter	m
yard	× 0.914 4	= meter	m
Mass			
pound$_{mass}$(avoird.)	× 0.453 6	= kilogram	kg
slug	× 14.59	= kilogram	kg
ton (long, 2240 lb$_m$)	× 1 016	= kilogram	kg
ton (short, 2000 lb$_m$)	× 907.2	= kilogram	kg
ton (metric)	× 1 000	= kilogram	kg
Mass/Time			
pound$_{mass}$/second	× 0.453 6	= kilogram/second	kg/s
Mass/Volume or Density			
gram/cm^3	× 1 000	= kilogram/meter^3	kg/m^3
pound$_{mass}$/foot^3	× 16.02	= kilogram/meter^3	kg/m^3
pound$_{mass}$/gallon	× 119.8	= kilogram/meter^3	kg/m^3
slug/foot^3	× 515.4	= kilogram/meter^3	kg/m^3
Power			
BTU/second	× 1 054	= watt	W
BTU/minute	× 17.57	= watt	W
BTU/hour	× 0.293 1	= watt	W
calorie/second	× 4.184	= watt	W
calorie/minute	× 0.069 73	= watt	W
foot-pound$_{force}$/second	× 1.356	= watt	W

TABLE 4. (cont'd) CONVERSION TO SI UNITS FOR PHYSICAL QUANTITIES FREQUENTLY USED IN WATER RESOURCES PRACTICE

To Convert From:	Multiply By:	To Obtain:	Units
horsepower (550 ft lb$_f$/s)	× 745.7	= watt	W
horsepower (electric)	× 746.0	= watt	W
horsepower (water)	× 746.0	= watt	W
Pressure or Stress or Force/Area			
atmosphere	× 1.013 E+5	= pascal	Pa
bar	× 1.000 E+5	= pascal	Pa
dyne/cm^2	× 0.100 0	= pascal	Pa
foot of water (39.4°F)	× 2 989	= pascal	Pa
gram$_{force}$/cm^2	× 98.07	= pascal	Pa
inches of mercury	× 3 386	= pascal	Pa
inches of water (39.4°F)	× 249.1	= pascal	Pa
kilogram$_{force}$/meter^2	× 9.807	= pascal	Pa
kip/inch^2(ksi)	× 6.895 E+6	= pascal	Pa
millibar	× 100	= pascal	Pa
millimeters of mercury	× 133.3	= pascal	Pa
pound$_{force}$/foot^2	× 47.88	= pascal	Pa
pound$_{force}$/inch^2 (psi)	× 6 895	= pascal	Pa
Stress (see Pressure)			
Temperature			
degree Celsius	+ 273.15	= kelvin	K
degree Fahrenheit	+ 459.67 ÷ 1.8	= kelvin	K
degree Rankine	÷ 1.8	= kelvin	K
degree Fahrenheit	− 32 ÷ 1.8	= degree Celsius	
Time			
day	× 8.640 E+4	= second	s
hour	× 3 600	= second	s
minute	× 60.00	= second	s
month (mean calendar)	× 2.628 E+6	= second	s
year (calendar)	× 3.154 E+7	= second	s
Torque (see Bending Moment)			
Velocity or Speed			
foot/second	× 0.304 8	= meter/second	m/s
foot/minute	× 0.005 080	= meter/second	m/s
foot/hour	× 8.467 E−5	= meter/second	m/s
kilometer/hour	× 0.277 8	= meter/second	m/s
mile/hour	× 0.447 0	= meter/second	m/s
Viscosity			
centipoise	× 0.001 000	= pascal − second	Pa·s
centistokes	× 1.000 E−6	= meter^2/second	m^2/s
foot^2/second	× 0.092 90	= meter^2/second	m^2/s
poise	× 0.100 0	= pascal − second	Pa·s
pound$_{force}$ − second/foot^2	× 47.88	= pascal − second	Pa·s
slug/foot-second	× 47.88	= pascal − second	Pa·s
stokes	× 1.000 E−4	= meter^2/second	m^2/s
Volume or Capacity			
acre-foot	× 1 233	= meter^3	m^3

TABLE 4. (cont'd) CONVERSION TO SI UNITS FOR PHYSICAL QUANTITIES FREQUENTLY USED IN WATER RESOURCES PRACTICE

To Convert From:		Multiply By:	To Obtain:	Units
barrel (oil, 42 gal)	×	0.159 0	= meter^3	m^3
board foot	×	0.002 360	= meter^3	m^3
bushel (U.S.)	×	0.035 24	= meter^3	m^3
foot^3	×	0.028 32	= meter^3	m^3
gallon (U.S. liquid)	×	0.003 785	= meter^3	m^3
inch^3	×	1.639 E−5	= meter^3	m^3
liter	×	0.001 000	= meter^3	m^3
yard^3	×	0.764 6	= meter^3	m^3
Volume/Time or Discharge or Flow Rate				
foot^3/second	×	0.028 32	= meter^3/second	m^3/s
foot^3/minute	×	4.719 E−4	= meter^3/second	m^3/s
gallon/minute	×	6.309 E−5	= meter^3/second	m^3/s
gallon/day	×	4.381 E−8	= meter^3/second	m^3/s
Work (see Energy)				

TABLE 5. COMMONLY USED EQUIVALENT UNITS IN WATER RESOURCES[1]

A. LENGTH:

Unit	Equivalent[a] [b]					
	millimeter	inch	foot	meter[c]	kilometer	mile
millimeter	1	0.039 37	0.003 281	0.001 000	1 E-6	0.621 4 E-6
inch	25.40	1	0.083 3	0.025 40	25.40 E-6	15.78 E-6
foot	304.8	12	1	0.304 8	304.8 E-6	189.4 E-6
meter[c]	1 000	39.37	3.281	1	0.001	621.4 E-6
kilometer	1 000 000	39 370	3 281	1 000	1	0.621 4
mile	1 609 000	63 360	5 280	1 609	1.609	1

[1]Footnotes for all parts of Table 5

(a) Equivalent values are shown to 4 significant figures.

(b) Multiply the numerical amount of the given unit by the equivalent value shown (per single amount of given unit) to obtain the numerical amount of the equivalent unit (e.g., 5 inches × 0.025 40 m/inch = 0.127 0 m).

(c) This is the SI expression, in base units or derived units, for the physical quantity.

B. AREA

Unit	Equivalent[a] [b]						
	sq. inch	sq. foot	sq. meter[c]	acre	hectare	sq. kilometer	sq. mile
sq. inch	1.	0.006 944	645.2 E-6	0.159 4 E-6	64.52 E-9	645.2 E-12	249.1 E-12
sq. Foot	144	1	0.092 90	22.96 E-6	9.290 E-9	92.90 E-9	35.87 E-9
sq. meter[c]	1 550	10.76	1	247.1 E-6	1 E-4	1 E-6	386.1 E-9
acre	6 273 000	43 560	4 047	1	0.404 7	0.004 047	0.001 563
hectare	15 500 000	107 600	10 000	2.471	1	0.01	0.003 861
sq. kilometer	1.550 E+9	10 764 000	1 000 000	247.1	100	1	0.386 1
sq. mile	4.014 E+9	27 880 000	2 590 000	640	259	2.590	1

C. VOLUME:

Unit	Equivalent[a] [b]							
	cu. inch	liter	U.S gallon	cu. foot	cu. yard	cu. meter[c]	acre-foot	sec-foot-day
cubic inch	1	0.016 39	0.004 329	578.7 E-6	21.43 E-6	16.39 E-6	13.29 E-9	6.698 E-9
liter	61.02	1	0.264 2	0.035 31	0.001 308	0.001	810.6 E-9	408.7 E-9
U.S. gallon	231.0	3.785	1	0.133 7	0.004 951	0.003 785	3.068 E-6	1.547 E-6
cubic foot	1 728	28.32	7.481	1	0.037 04	0.028 32	22.96 E-6	11.57 E-6
cubic yard	46 660	764.6	202.0	27	1	0.764 6	619.8 E-6	312.5 E-6
cubic meter[c]	61 020	1 300	264.2	35.31	1.308	1	810.6 E-6	408.7 E-6
acre-foot	75.27 E+6	1 233 000	325 900	43 560	1 613	1 233	1	0.504 2
second-foot-day	149.3 E+6	2 447 000	646 400	86 400	3 200	2 447	1.983	1

D. DISCHARGE (FLOW RATE, VOLUME/TIME):

Unit	Equivalent[a] [b]					
	gallon/min	liter/sec	acre-foot/day	foot^3/sec	million gal/day	meter^{3}sec[c]
gallon/minute	1	0.063 09	0.004 419	0.002 228	0.001 440	63.09 E-6
liter/second	15.85	1	0.070 05	0.035 31	0.022 82	0.001
acre-foot/day	226.3	14.28	1	0.504 2	0.325 9	0.014 28
foot^3/second	448.8	28.32	1.983	1	0.646 3	0.028 32
million gallons/day	694.4	43.81	3.069	1.547	1	0.043 81
meter^3/second[c]	15 850	1 000	70.04	35.31	22.82	1

E. VELOCITY:

Unit	Equivalent[a] [b]				
	foot/day	kilometer/hour	foot/sec	mile/hour	meter/sec[c]
foot/day	1	12.70 E-6	11.57 E-6	7.891 E-6	3.528 E-6
kilometer/hour	78 740	1	0.911 3	0.621 4	0.277 8
foot/second	86 400	1.097	1	0.681 8	0.304 8
mile/hour	126 700	1.609	1.467	1	0.447 0
meter/second[c]	283 500	3.600	3.281	2.237	1

F. MASS:

Unit	Equivalent[a] [b]					
	pound$_{mass}$	kilogram[c]	metric slug	slug	metric ton	long ton
pound$_{mass}$ (avoird.)	1	0.453 6	0.046 25	0.031 08	453.6 E-6	446.4 E-6
kilogram[c]	2.205	1	0.102 0	0.068 52	0.001	984.2 E-6
metric slug	21.62	9.807	1	0.672 1	0.009 807	0.009 651
slug	32.17	14.59	1.490	1	0.014 59	0.014 36
metric ton	2 205	1 000	102.0	68.52	1	0.984 2
long ton	2 240	1 016	103.7	69.63	1.016	1

G. FORCE

Unit	Equivalent[a] [b]			
	dyne	newton[c]	$pound_{force}$	$kilogram_{force}$
dyne	1	1 E-5	2.248 E-6	1.020 E-6
newton[c]	100 000	1	0.224 8	0.102 0
$pound_{force}$	444 800	4.448	1	0.453 6
$kilogram_{force}$	980 700	9.807	2.205	1

TABLE 6. COMMONLY USED NUMERICAL VALUES FOR PHISICAL PROPERTIES

Quantity	U.S. FLT System[1]	SI System
Gravitational acceleration g (std., free fall)	32.2 ft/s^2	9.807 m/s^2
Density of water, ρ_{H_2O} @ 50°F/10°C	1.94 $slugs/ft^3$	1 000 kg/m^3
Specific weight of water, γ_{H_2O} @ 50°F/10°C	62.4 lb/ft^3	9.807 kN/m^3
Dynamic viscosity of water, μ_{H_2O} @ 50°F/10°C	2.73×10^{-5} lb·s/ft^2	1.30×10^{-3} Pa·s
@ 70°F/20°C	2.05×10^{-5} lb·s/ft^2	1.00×10^{-3} Pa·s
Kinematic viscosity of water, ν_{H_2O} @ 50°F/10°C	1.41×10^{-5} ft^2/s	1.30×10^{-6} m^2/s
@ 70°F/20°C	1.06×10^{-5} ft^2/s	1.00×10^{-6} m^2/s
Atmospheric pressure, p (std.)	14.70 psia 2 116 psfa	101.3 kPa

[1]This is presented for illustrative purposes only, as the C.E. Textbooks in fluid mechanics have generally used the FLT System alone, prior to introduction of SI units in new textbooks beginning in 1975.

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